



betterSoil
FOR A BETTER WORLD

DISCUSSION PAPER

Improving soil quality for climate resilience, climate protection and sustainable food production

English

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We need courage, foresight and concrete action from multiple stakeholders!

betterSoil for a better world!

Imprint

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SUMMARY

In the last decades, climate change has adversely affected many societies and sectors, including agriculture and food systems. These impacts are increasing due to the rising mean temperature of the Earth's surface. Loss of soil organic matter and fertility, soil erosion and degradation are threatening hundreds of millions of livelihoods each year and have therefore been on the agenda of many international organizations such as the United Nations, the Food and Agriculture Organization (FAO), the United Nations Convention to Combat Desertification (UNFCCC) as well as the United Nations Framework Convention on Climate Change (UNFCCC) for decades.

Soil is the fundament for life on Earth and soil fertility is essential to agricultural production, food as well as nutrition security and support of livelihoods. Agriculture and food systems depend on soil in an existential way and unsustainable soil management has already led to losing parts of this vital resource for current and future generations. Humanity urgently needs a betterSoil for a sustainable food production. A betterSoil is strong, fertile and full of life. It is rich in humus, a reliable source of food for the growing human population, highly resilient and able to withstand extreme weather conditions driven by climate change. It is also home to a variety of underground organisms. The concept of a betterSoil is an integral and systemic approach which emphasizes the whole without disregarding the necessary constituents. It connects economic profitability with sustainable practices, with craftsman-like expertise, with respect for nature, with scientific research and with a globally oriented approach to combat climate change.

The betterSoil can be achieved all around the world with the help of four simple principles: a) appropriate soil treatment, b) sustainable crop management, c) intelligent use of natural soil additives such as compost and biochar, and d) the inclusion of perennial crops as in agroforestry systems. These principles, properly applied, increase the potential to enhance/restore soil organic matter (humus) and protect soil fertility for the future.

Humus is the key to fertile soil. Humus is a natural storehouse for water and nutrients and provides space for soil organisms, which are crucial for plant health and growth. This not only increases crop yields, which is absolutely necessary in times of a high rate of biodiversity loss because of the expansion for agricultural fields; it also guards against extreme weather conditions and helps to balance nutrient availability to plants. Humus basically makes the soil a living and resilient organism, working for the greater good of food and nutrition security and stabilizing yields under increasing pressure. Moreover, humus is responsible for the health of soils and healthy soils are key to healthy and nutritious food.

The most surprising advantage of a betterSoil is the sequestration of atmospheric carbon dioxide (CO₂). Combining humus enhancement with biochar turns the soil into an effective carbon sink and a potential game changer. This concerns the fight against a climate crisis and for sustainable development, especially in low- and middle-income countries. Indeed, a betterSoil can fuel economic development in low-income countries, while contributing to climate action and mitigation at the same time. This links global action to local efforts. After all, achieving a betterSoil is economically

feasible, even for small-scale farmers, and can therefore be achieved all over the world.

WHERE ARE WE CURRENTLY HEADING TOWARDS?

The negative impacts of changing climate, due to temperature rise, are affecting societies globally. Extreme weather conditions, longer dry seasons as well as heavy rains and floods, erosion, landslides, salinization, loss of organic matter and desertification are the changing conditions which often adversely affect societies. In the last years, many organizations such as the Intergovernmental Panel on Climate Change (IPCC) have stated that these negative impacts will drastically increase by the end of this century when the average temperature may rise by about 3.7 to 4.8°C, unless seriously large-scale mitigation actions are taken. Including climate uncertainties in the projection, even higher temperature, 2.5 to 7.8°C, could be expected.¹

In 2015, the nations of the world articulated their common will to limit the rise of global mean temperature to below 2°C compared to pre-industrial times within the Paris Agreement. In the same year, the 17 Sustainable Development Goals (SDGs) were adopted by the United Nations. The SDGs aim at a world without poverty and hunger, while at the same time leaving habitat for biodiversity and stabilizing the climate. But such a better world requires massive economic growth and wealth

creation, among others to address growing needs worldwide and a rapid growing world's population. The increase in prosperity is currently linked to more resource consumption and higher CO₂ emissions. With the current state of the art, the complicated question of the simultaneous feasibility of the SDGs, the adequate supply of all nations with energy as the basis for prosperity and the limitation of the earth's warming to below 2°C ultimately remains unanswered within the frameworks of the SDGs and the Paris Agreement and are therefore unlikely to be implemented.

Soil is the fundamental resource for life, development and for feeding a growing population. It also plays an important role in the climate system. Depending on soil's condition and how this resource is treated, it can sharpen the adverse impacts of climate change or help to mitigate and to build up resilience against it. Agriculture plays a very important role in this context because it can either worsen or improve soil conditions. Currently, agriculture contributes to 23% of total anthropogenic greenhouse gas (GHG) emissions, is responsible for 80% of deforestation and biodiversity loss², 70% of freshwater use³ and pollutions in underground water as well as aquatic ecosystems⁴. Sadly enough, greenhouse gas emissions from agriculture, forestry and fisheries have nearly doubled over the past 50 years, and could even increase by an additional 30% by 2050 – if there are no

¹ Intergovernmental Panel on Climate Change, IPCC: *Climate Change: Mitigation of Climate Change*, 8, 2014.

² Wageningen University and Research Centre: *Agriculture is the direct driver for worldwide deforestation*. ScienceDaily. ScienceDaily, 25 September 2012. Available under: www.sciencedaily.com/releases/2012/09/120925091608.htm.

³ World Bank: *Water in Agriculture*, 2020. Available under <https://www.worldbank.org/en/topic/water-in-agriculture>

⁴ Food and Agriculture Organization of the United Nations (FAO), International Water Management Institute (IWMI) and Water Land and Ecosystems research program: *Water pollution from agriculture: a global review*, 2017.

greater efforts to reduce them.⁵ As a consequence, the food production system has been adversely affected by climate change, while climate change has been negatively affected by food production. This is due to unsustainable practices, which consequently lead to soil loss, erosion and degradation. Unsustainable agricultural practices prevent the soil from adequately fulfilling its diverse functions for humans and ecosystems. This leads to a decrease in soil fertility, carbon content and biodiversity, a lower water retention capacity, disturbances in the gas and nutrient cycle and a reduced degradation of pollutants. The deterioration in soil quality has a direct impact on the quality of water and air, biodiversity and climate change.

The risk of soil loss increases significantly with ongoing climate change all over the globe and will even continue in Europe possibly at a faster pace. In this context, desertification due to soil erosion is another cross cutting global challenge which threatens many livelihoods in Europe – around 45% of European soils have a reduced content of organic substances and out of 27 EU Member States, 13 have already declared that they are affected by desertification. Desertification affects not only Mediterranean regions, but also Central and Eastern Europe. Diminishing food production, loss of soil fertility, a decrease in the land's natural resilience and reduced water quality, an increase in poverty and loss of livelihoods are results which force people to migrate.^{6,7}

WHAT CAN BE DONE?

The potential contribution of the agricultural sector to better living conditions, a stable climate and a healthy ecosystem is enormous. Not only in Europe, the sector is a key area of development cooperation, on which a large part of the world population depends. An innovative approach to agriculture would turn the negative impacts of the current situation around. Soils would function as a sink for greenhouse gas emissions while increasing soil fertility for better food quality, while increasing water holding capacity to combat desertification and while preserving biodiversity. An innovative approach to agriculture makes practices in this direction economically viable for farmers.

Soil is the fundament for living and agricultural systems therefore need betterSoils. A betterSoil is humus rich, strong, fertile and full of life. Humus is essential for soil fertility and can significantly change the properties of the soil for the better. Around 2500 gigatons of carbon are bound in humus worldwide - more than three times the total amount of carbon in the atmosphere and five times the amount bound in the world's plant mass. Carbon remains bound in humus-rich soil for hundreds of years. Through humus formation, billions of hectares of valuable soils, that have been degraded through incorrect or excessive use or have been lost through desertification, can be made fertile again. Humus formation can change our current agriculture.

⁵ Food and Agriculture Organization (FAO): *Soils help to combat and adapt to climate change*, 2015.

⁶ Desertification in the EU (European court of Auditors), 2018

⁷ euronews: *What will be the new face of European agriculture in the coming years?* Copernicus Europe's eyes on Earth, 2020. Available under: <https://www.euronews.com/2020/03/02/what-will-be-the-new-face-of-european-agriculture-in-the-coming-years>

HUMUS DETERMINES HOW HEALTHY AND FERTILE THE SOIL IS.

SOIL WITH HUMUS ...

- ✓ **contains more life than there are people on earth**

soil with humus has a high population of micro-organisms and a handful of soil has more organisms than people on earth.⁸ Humus is a key factor for the abundance and diversity of the microfauna and any kind of soil treatment as well as application of minerals and chemicals that kill these microorganisms and destroy their habitat lead to humus and fertility loss,

- ✓ **has a high absorption capacity for water**

a soil well supplied with humus can absorb up to 150 litres of water per hour. During extreme rainfalls that appear more often in changing climate, soil rich in humus can readily take up high amount of rainwater and facilitates the water flow into the soil,

- ✓ **has a high storage capacity for water**

up to an additional 400 m³ of water per hectare can be stored per 1 % increase in humus. Humus acts like a sponge and absorbs moisture

during rainfall while releasing water afterwards and thus helps plants during long dry seasons,

- ✓ **has enormous storage capacity for nutrients**

1% humus at 30 cm soil depth means a nitrogen pool of an additional 2500 kg per hectare. In other words, humus is a storehouse for soil nutrients, preventing them from being leached and washed away,

- ✓ **has high filtering and buffering effect**

the higher the humus content, the better the pollutants can be captured and subsequently degraded, the sponge effect. This includes filtering as well as purifying groundwater and rainwater,

- ✓ **once saturated with water and nutrients, lets additional rainwater flow through to form groundwater.**

Humus is like large/coarse grinded coffee powder which allows the coffee to flow into your coffee cup. Humus-poor soil, to the contrary, is like coffee which was ground to fine. Water cannot get through. You get no coffee. In this case, you allow no groundwater flow in the soil,

- ✓ **makes the production safer and cheaper in the long run**

humus helps to significantly reduce the entire plant protection effort as well as its costs,¹⁵

⁸ The Award of the German Environment Prize 2019. Interview with Prof. Dr. Ingrid Kögel-Knabner. Available on: <https://www.youtube.com/watch?v=mC1VRxu1qYE>

✓ **increases plant health and productivity**

the higher the humus content, the more active the soil, the healthier the plants can become. Humus increases plant health by enabling balanced plant nutrition, by facilitating interactions between plant roots, soil microbes and the soil structure. Moreover, humus feeds and protects microbes in the soil, traps oxygen, which is essential for root development and helps root structures to grow by contributing to improved vigor,

✓ **preserves biodiversity of/in forests, wetlands and peatlands**

the higher the humus content, the higher the yields per unit land, therefore the lower is the need for expanding lands,

✓ **has a high carbon sequestration potential⁹**

humus can bind 2-25 tons of CO₂ per hectare and year,^{10,11,12,13}

✓ **can help to increase farmer's reputation**

the farmer, while feeding people, becomes a climate protector and fosters sustainable developments: These include climate protection, water protection by reducing nitrate pollution, soil conservation by maintaining or rebuilding soil fertility, organic production by less or ideally no

pesticide use, healthier food and more beautiful landscapes through hedges and agroforestry systems,

✓ **prevents erosion by holding soil particles together**

humus protects the soil from extremes in temperature and maintains soil pH, helping to correct soil's pH problems.

These facts alone show that humus has an extreme importance in the carbon and nitrogen cycle and can significantly contribute to close these cycles. Humus can highly contribute to mitigate climate change while providing multiple ecosystems services (co-benefits) for people.¹⁴ Indeed, IPCC 2007 has estimated that farming has a mitigation potential of 5.5-6 Gt CO₂e per year especially by soil carbon sequestration.

Humus formation practices can increase soil quality and fertility and simultaneously sequester anthropogenic GHG emissions. These practices include appropriate soil treatment and sustainable crop management such as the use of green manure including legumes, cover crops, perennial plants, crop rotation (e.g. maize-cereals/grains-maize or maize-winter barley-soya), intercropping (e.g. maize + beans, wheat + false flax, sunflower + buckwheat), catch crop (e.g. white clover under maize or cereals), application of compost as

⁹ Lal, R., Smith, P., Jungkunst, H. F., Mitsch, W. J., Lehmann, J., Nair, P. R., ... & Skorupa, A. L. *The carbon sequestration potential of terrestrial ecosystems*. Journal of Soil and Water Conservation, 73(6), 145A-152A, 2018.

¹⁰ Dunst, G.: *Humusaufbau: Chance für Landwirtschaft und Klima*. Verein Ökoregion Kaindorf, 2015.

¹¹ Jones, C. E.: *Liquid carbon pathway unrecognised*. Australian Farm Journal, 8(5), 15-17.5, 2008.

¹² Luske, B., & van der Kamp, J.: *Carbon sequestration potential of reclaimed desert soils in Egypt*, 2009.

¹³ Johnson, D., Ellington, J., & Eaton, W.: *Development of soil microbial communities for promoting sustainability in agriculture and a global carbon fix* (No. e789v1). PeerJ PrePrints, 2015.

¹⁴ Lal, R., Negassa, W., & Lorenz, K. *Carbon sequestration in soil*. Current Opinion in Environmental Sustainability, 15, 79-86, 2015.

well as biochar and incorporation of agroforestry systems. Adopting some of these practices could bring the soil again on track to become a betterSoil for a better world!

Humus farming and climate positive agriculture have an immense potential to help achieve SDGs while mitigating climate change. “Eradicating poverty and ensuring food security can benefit from applying measures promoting land degradation neutrality (including avoiding, reducing and reversing land degradation) in rangelands, croplands and forests, which contribute to combating desertification, while mitigating and adapting to climate change within the framework of sustainable development”.¹⁵

WHAT ARE THE GOALS OF THIS PAPER?

There is an urgent need to establish large-scale betterSoil farming practices not only to implement the SDGs, e.g. increase yield for a growing population but also to reduce atmospheric GHG emissions. For this purpose, there is a lot to do:

TO THE PRACTITIONERS/FARMERS IN THE AGRICULTURAL SECTOR (EUROPE + WORLD-WIDE):

BetterSoil farming practices must globally receive more attention in practice. It is extremely important that practitioners help closing the natural cycles through their farming practices, primarily the carbon and nitrogen cycles. Closing these cycles is absolutely

necessary for soil improvement. That these two cycles are open is one of the main reasons for the atmospheric imbalance and hence for climate change. Instead, putting farms’ focus on closing the cycles by practicing a humus economy can bind carbon and nitrogen in the soil. Practitioners and farmers can build the bridge between climate protection and economic development. They can bring betterSoil practices onto fields and put them into practice. Be sure when doing so, enormous benefits are going to be created, as mentioned above, compared to the costs. BetterSoil practices make farms more resilient against the negative impacts of climate change.

TO THE PRIVATE SECTOR (INDUSTRY, ENTREPRENEURS AND BUSINESS LEADERS):

Running a targeted humus economy and closing the carbon and nitrogen cycles creates costs, at least for some years in the transition phase. Actors of the private sector can financially support this transition through internalizing externalities voluntarily, a topic that has been ignored for years. Currently the private sector overall owns 5-7 times more capital and wealth than the nation states.¹⁶ Private sector actors can provide financial support to projects aiming to enhance humus and to increase soil quality while removing GHGs from the atmosphere. These projects can bind atmospheric CO₂ and thus contribute directly to climate protection and development. They are one of the few cases of a positive correlation between wealth promotion in the sense of the SDGs and climate protection. Through this, they contribute to overcoming internal

¹⁵ Intergovernmental Panel on Climate Change, IPCC: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*, 2019.

¹⁶ Alvaredo, F., Chancel, L., Piketty, T., Saez, E., & Zucman, G. (Eds.). *World inequality report 2018*. Belknap Press, 2018.

contradictions between individual SDGs. Therethrough, the question of economic growth (SDG 8) without stressing the climate (SDG 13) and without destroying habitats and reducing biodiversity (SDG 14 and SDG 15) can be addressed. The private sector can immensely contribute to fulfilling these global goals, the SDGs and therethrough sketch a better world!

TO THE NATION STATES:

The individual states have high responsibility and competencies on this issue. They should bring betterSoil measurements into practice in their countries, integrate them into their policies as rewarding measurements to encourage more farmers to act as climate protectors and to foster economic development. Agricultural production is predominantly managed by thousands of small farms in their countries and is therefore a big business. The nation states should support small-, medium- and large-scale farmers economically and politically to make not only them but also the country's food production more resilient against the adverse negative impacts of climate change through adopting betterSoil practices. It should be economically viable to implement them.

TO THE EUROPEAN UNION:

The European Union can initiate projects and activities on thousands of hectares not only on European level but also on a global scale, promoting betterSoil practices and humus enhancement on degraded and sandy soils. Such projects are also able to make eroded European soils fertile again, bind atmospheric CO₂ and thus contribute directly to climate protection and resilience for European farmers. The Green New Deal and research programs like

Horizon 2020 could be good platforms for that. In addition, the EU should build a much stronger focus on betterSoil and humus enhancement principles into its Common Agricultural Policy (CAP). Moreover, the EU can integrate betterSoil farming practices and soil carbon enhancement as rewarding measures into their policies. Meaning, farmers and actors who have hand in the food production and managing soil would be rewarded to close carbon and nitrogen cycles, meaning to avoid, to reduce as well as to remove atmospheric GHGs and to do something good for the climate.

TO INDIVIDUALS ALL AROUND THE WORLD:

Raise awareness, act as betterSoil ambassadors and advertise for the benefits of betterSoil, join us on this journey, mobilize at least 2 members of your family, friends and colleagues to join us, motivate actors of the private and political sector for more engagement for global climate protection and development through betterSoil practices. Financially support the projects and farmers who apply betterSoil farming practices globally and locally. Become climate neutral yourself and remember: your participation matters to solving the global puzzle towards a better world!

This paper aims to raise awareness for betterSoil farming practices and to win public / private attention. The paper also promotes action on the European and global level through ministries, international organizations, United Nations, FAO as well as CFS HLPE (parallel to their current movements and calls to make our soils humus-better) and many more. Politicians, investors, farmers, scientists, pupils, workers, students and all others are invited to join us. We need your power!

We need courage, foresight and concrete action from multiple stakeholders!

betterSoil for a better world!

The betterSoil Initiative is linked with other FAW/n activities. FAW/n works closely with the German Federal Ministry for Economic Cooperation and Development (BMZ) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), namely the [Marshallplan with Africa](#) and the [Development and Climate Alliance](#).

The Alliance motivates non-state actors to voluntarily internalize their externalities and to positively contribute to fulfil the SDGs and climate protection via suitable projects and activities in low- and middle-income countries. Nature-based Solutions, creating negative emissions, are an important part of this. This constitutes a close link to betterSoil.

FAW/n also cooperates with BMZ and GIZ on the promotion of green hydrogen and methanol, CO₂-recycling and synthetic fuels which are among the few remaining options to address both, climate protection and development in a world with ongoing massive population growth. The positive impacts of green synthetic fuels can be further enhanced, if they are linked to projects promoted by the Development and Climate Alliance, among them betterSoil projects.

